

**What Is Claimed Is:**

1. An optical disk playback apparatus for playing back main data and an associated sub-code read from an optical recording medium, said apparatus comprising:

an interleave RAM for storing the main data; and

5 interleave RAM control means for writing a sub-code synchronization signal generated by performing a predefined synchronization protection on synchronization information included in the sub-code into an empty area of said interleave RAM to manage addresses with a FIFO area in a manner similar to the main data, causing the read sub-code synchronization signal to function in  
10 synchronization with the main data.

2. The apparatus according to claim 1, further comprising:

a buffer memory for external output,

wherein the sub-code synchronization signal controls start of a write into said buffer memory when the main data read from said interleave RAM is  
5 stored in said buffer memory as decoded data.

3. The apparatus according to claim 1, wherein said empty area for storing the sub-code synchronization signal is a memory area adjacent to a position at which a data symbol allocated an interleave delay is placed out of a group of data symbols in each frame into which the main data is written.

4. The apparatus according to claim 3, wherein said empty area for storing the sub-code synchronization signal has a memory size with margin addresses equivalent to a data symbol which is allocated the minimum or

maximum interleave delay.

5. The apparatus according to claim 1, wherein said interleave RAM control means includes synchronization signal writing means for writing the sub-code synchronization signal into said interleave RAM once per frame.

6. The apparatus according to claim 1, wherein said interleave RAM includes an area in said empty area for storing the sub-code synchronization signal, said area including a margin address area for controlling a delay due to a FIFO operation.

7. The apparatus according to claim 1, wherein said sub-code synchronization signal stored in said empty area of said interleave RAM comprises one bit.

8. The apparatus according to claim 1, further comprising means for storing, in said empty area of said interleave RAM, symbol data in which a sub-code symbol bit P is replaced with bit data which is the sub-code synchronization signal, and separating a sub-code synchronization signal, a Q-bit, an R-bit, an S-bit, a T-bit, a U-bit, a V-bit and a W-bit from the symbol data retrieved through de-interleaving.

9. The apparatus according to claim 1, wherein minimum configuration for storing said sub-code synchronization signal includes three storage areas including a storage area for margin addresses, a storage area for storing a data write address, and a storage area for storing a data read address.

10. An optical disk playback apparatus for playing back main data and an associated sub-code read from an optical recording medium, said apparatus comprising:

- an interleave RAM for storing the main data; and
- 5 interleave RAM control means for writing a sub-code synchronization signal generated by performing a predefined synchronization protection on synchronization information included in the sub-code into an empty area of said interleave RAM to manage addresses with a FIFO area in a manner similar to the main data, causing the sub-code synchronization signal read from said
- 10 interleave RAM to function as a sub-code synchronization signal synchronized with the main data,
- said interleave RAM control means including means for writing, when said FIFO area included in said interleave RAM is centered in response to an underflow of said FIFO area, "0" data into addresses of a sub-code
- 15 synchronization signal storage area jumped by said centering.

11. The apparatus according to claim 10, wherein in management of addresses with the FIFO area of said interleave RAM, a read address is centered with reference to a write address when said managed FIFO area overflows or underflows.

12. An optical disk playback apparatus for playing back main data and an associated sub-code read from an optical recording medium, said apparatus comprising:

- an interleave RAM for storing the main data;
- 5 interleave RAM control means for writing a sub-code synchronization signal generated by performing a predefined synchronization protection on

synchronization information included in the sub-code into an empty area of said  
interleave RAM to manage the address with a FIFO area in a manner similar to  
the main data, causing the sub-code synchronization signal read from said  
10 interleave RAM to function as a sub-code synchronization signal synchronized  
with the main data,

synchronization signal masking means for masking the sub-code  
synchronization signal read from said Interleave RAM for a certain period from  
an underflow of said FIFO area to a read of addresses of a sub-code  
15 synchronization signal storage area jumped by centering of said FIFO area.

13. The apparatus according to claim 12, wherein in management of  
addresses with the FIFO area of said Interleave RAM, a read address is  
centered with reference to a write address when said managed FIFO area  
overflows or underflows.

14. An optical disk playback apparatus for playing back main data and  
an associated sub-code read from an optical recording medium, said apparatus  
comprising:

an Interleave RAM for storing the main data; and  
5 double synchronization protecting means for storing the main data in  
said interleave RAM, and also writing a 1-bit sub-code synchronization signal  
generated by performing a predefined first synchronization protection on  
synchronization information included in the sub-code into an empty area of said  
interleave RAM, and performing a second synchronization protection different  
10 from the first synchronization protection on the sub-code synchronization signal  
read from said Interleave RAM together with the main data.

15. The apparatus according to claim 14, wherein:  
 said first synchronization protection regards first and second  
 synchronization information included in the sub-code only as the  
 synchronization information when the first and second synchronization  
 5 information is continuous in a result of periodically counting the first and second  
 synchronization information; and  
 said second synchronization protection again inserts a sub-code  
 synchronization signal or ignores the sub-code synchronization signal read from  
 said interleave RAM in accordance with the result of the periodic count.

16. An optical disk playback apparatus for playing back main data and  
 an associated sub-code read from an optical recording medium, said apparatus  
 comprising:  
 a flag RAM for storing a flag signal associated with the main data; and  
 5 flag RAM control means for writing a sub-code synchronization signal  
 generated by performing a predefined synchronization protection on  
 synchronization information included in the sub-code into an empty area of said  
 flag RAM to manage addresses with a FIFO area in a manner similar to the  
 main data, causing the sub-code synchronization signal read from said flag  
 10 RAM to function in synchronization with the main data.

17. The apparatus according to claim 16, wherein said flag RAM  
 includes a storage area for storing the sub-code synchronization signal, said  
 storage area having a memory capacity in accordance with a margin address  
 capacity of said FIFO area which is previously set in accordance with a capacity  
 5 of the empty area of said flag RAM.

18. An optical disk playback apparatus comprising:

a PLL circuit for generating a bit clock from main data and an associated sub-code read from an optical recording medium which stores said main data and said sub-code;

5 data detecting and demodulating means for receiving the bit clock, the main data and the sub-code, detecting synchronization information, demodulating EFM modulated main data, and delivering the demodulated main data;

synchronization protecting/error correcting/Q-code separating means for  
10 delivering a Q-code CRC determination signal resulting from a CRC-based error check on the basis of the synchronization information and the demodulated main data, a Q-code data symbol, and a sub-code synchronization signal generated by performing a synchronization protection on the synchronization information;

15 Q-code buffering means for reading time/position information from the Q-code data symbol;

an interleave RAM for storing the main data and the sub-code synchronization signal;

error correcting/memory control means for receiving symbols including  
20 the sub-code synchronization signal and the main data to perform a CIRC error correction thereon, managing addresses of a margin address area in each symbol area stored in said interleave RAM through a FIFO operation, storing the symbols including the sub-code synchronization signal in an empty area of said interleave RAM on a frame-by-frame basis, and delivering said sub-code  
25 synchronization signal and said main data which are read from the interleave RAM in synchronization;

a flag RAM for storing a result of the error correction;

a memory controller for receiving the main data and the sub-code  
synchronization signal read from said interleave RAM through said error

30 correcting/memory control means;

a buffer memory for storing the main data in synchronization with the  
sub-code synchronization signal; and

a CPU for managing the main data in association with the Q-code data  
symbol, and conducting a control for storing the main data in said buffer  
35 memory and an optical position control for the optical recording medium.

19. A data playback method for playing back main data and an  
associated sub-code read from an optical recording medium in an optical disk  
playback apparatus, said method comprising the steps of:

previously performing a predefined synchronization protection on  
5 synchronization information included in the sub-codes to generate a sub-code  
synchronization signal;

writing the sub-code synchronization signal in an empty area of an  
interleave RAM for storing the main data; and

managing addresses with a FIFO area in a manner similar to the main  
10 data to cause the sub-code synchronization signal read from said interleave  
RAM to function in synchronization with the main data.

20. The method according to claim 19, further comprising the step of:  
storing the sub-code synchronization signal in one of a plurality of bits in  
the empty area of said interleave RAM, and

storing a CRC error determination result for a symbol bit Q out of eight  
5 sub-code symbols P, Q, R, S, T, U, V, Q included in the sub-code in another  
one of the bits in the empty area.

21. The method according to claim 19, further comprising the steps of:  
storing symbol data in the empty area of said interleave RAM, said  
symbol data having a sub-code symbol bit P replaced with bit data which is the  
sub-code synchronization data; and

5 separating the sub-code synchronization signal and a Q-bit, R-bit, S-bit,  
T-bit, U-bit, V-bit and W-bit from the symbol data retrieved through de-  
interleaving.

22. A data playback method for playing back main data and an  
associated sub-code read from an optical recording medium in an optical disk  
playback apparatus, said method comprising the steps of:

previously performing a predefined synchronization protection on  
5 synchronization information included in the sub-code to generate a sub-code  
synchronization signal;

writing the sub-code synchronization signal into an empty area of a flag  
RAM for storing a flag signal of the main data; and

managing addresses with a FIFO area in a manner similar to the main  
10 data to cause the sub-code synchronization signal read from said flag RAM to  
function in synchronization with the main data.

23. The method according to claim 22, wherein when said flag RAM is  
used for storing the sub-code synchronization signal, said FIFO area has a  
margin address area which is previously set to a memory capacity determined  
in accordance with a capacity of an empty area of said flag RAM.

24. A data playback method for playing back main data and an  
associated sub-code read from an optical recording medium in an optical disk



playback apparatus, said method comprising the steps of:

previously performing a predefined synchronization protection on

5 synchronization information included in the sub-code to generate a sub-code synchronization signal;

writing the sub-code synchronization signal in an empty area of an interleave RAM for storing the main data;

managing addresses with a FIFO area in a manner similar to the main  
10 data to cause the sub-code synchronization signal read from said interleave RAM to function as a sub-code synchronization signal which synchronized with the main data;

centering said FIFO area included in said interleave RAM in response to an underflow of said FIFO area; and

15 writing "0" data at an address of a sub-code synchronization signal storage area which is jumped by the centering.

25. A data playback method for playing back main data and an associated sub-code read from an optical recording medium in an optical disk playback apparatus, said method comprising the steps of:

storing the main data in an interleave RAM;

5 performing a predefined first synchronization protection on synchronization information included in the sub-code to generate a 1-bit sub-code synchronization signal;

writing the sub-code synchronization signal into an empty area of said interleave RAM;

10 reading the sub-code synchronization signal from said interleave RAM together with the main data; and

performing a second synchronization protection different from the first

synchronization protection on the sub-code synchronization signal read from said interleave RAM.

26. The method according to claim 25, further comprising the steps of:  
periodically counting first and second synchronization information  
included in the sub-code;

5 regarding the first and second synchronization information as the sub-  
code synchronization signal through the first synchronization protection only  
when the first and second synchronization information is continuous; and  
inserting again the sub-code synchronization signal or ignoring the sub-  
code synchronization signal read from said interleave RAM in accordance with  
a result of the periodic counting, through the second synchronization protection  
10 for the first and second synchronization information.